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# DIGITAL PANEL METER

# OWNERS MANUAL

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# SERIES 400A/S DIGITAL PANEL METER
# OWNERS MANUAL

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## CERTIFICATION

Newport Laboratories, Inc., certifies that this (these) instrument(s) was (were) thoroughly inspected and tested at the factory prior to shipment and found to meet all requirements defined by the contract under which they are furnished.

## WARRANTY AND ASSISTANCE

All products of Newport Laboratories, Inc., are warranted against defective material and workmanship for a period of one year from the date of delivery. Newport Laboratories will repair or replace all defective equipment returned to it (transportation charges prepaid) during the warranty period, without charge provided there is no evidence that the equipment has been mishandled or abused. This warranty does not apply to expendable parts or materials whose normal life is less than the warranty period, nor is Newport Laboratories liable for consequential damages arising out of the use or handling of its products.

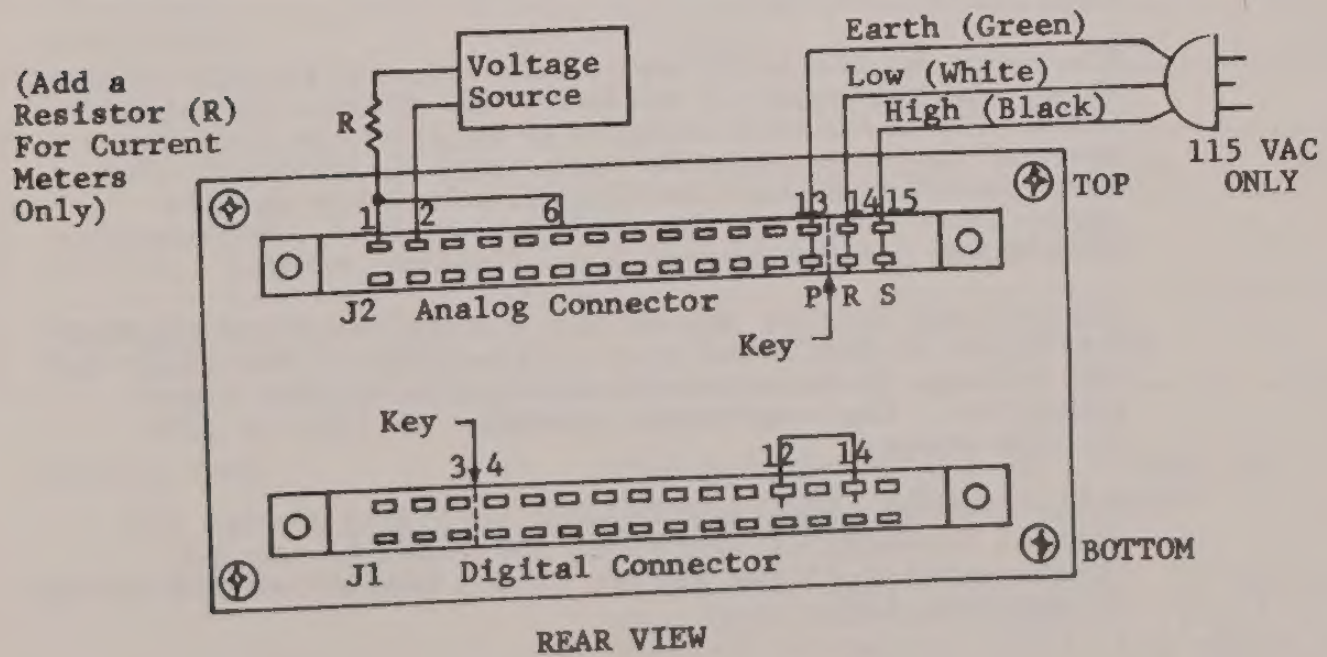
In all orders for service, please include the model and serial number and the name of the original purchaser of the equipment.

## INITIAL CHECKOUT PROCEDURE

1. Connect a voltage source (eg. power supply) between pins 1 and 2 on the upper (Analog) connector.
2. Connect a jumper between pins 1 and 6 on the same connector.
3. Connect a power cord to the upper (Analog) connector as follows:
   - A. To pins 15 and S connect the high or "hot" lead.
   - B. To pins 14 and R connect the low or "cold" lead.
   - C. To pins 13 and P connect the earth ground or "third wire".
4. Connect a jumper between pins 12 and 14 on the lower (Digital) connector.
5. Apply 115 VAC, ±10%, 50-60Hz to the power cord.
6. Adjust the input voltage source to be within the measurement range of the meter and verify that the meter is reading correctly.

**CAUTION**

Accidental connection of power to the Digital Board may result in catastrophic failure

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# SECTION 1

# DESCRIPTION

## 1.1 General

The Newport Series 400A/S digital panel meters are single range instruments designed to digitally indicate a DC input voltage or current. These panel meters provide readings up to ±3999 counts on any of 4 DC voltage and five DC current ranges. For applications compatible with .025% resolution and .1% basic accuracy the Series 400A/S offers a low-cost reliable approach to digital display of analog voltages and current. Utilizing highly stable integrating techniques they can complete from 4 to 60 full readings per second and on command will hold a reading indefinitely. When the input voltage exceeds full scale, the three least significant digits blank. Zero offset, full scale, and bias current adjustments are available through the rear panel.

The Series 400A/S bipolar instrument has true differential inputs to reduce ground-loop effects. Polarity of the input voltage is automatically selected and displayed as either "+" or "-".

Series 400A/S meters allow the decimal point to be set externally to any one of four positions. The BCD outputs and the external control inputs and outputs are compatible with TTL and DTL for ease in interfacing with other instruments.

The meter consists of two printed-circuit boards enclosed in an aluminum case to minimize the effects of external noise. Both circuit boards can be slid out thru the rear of the case once the rear panel is removed. The lower board contains the digital circuitry and the upper board contains the analog circuitry. The two boards are interconnected by a flexible cable.

Outputs and Control Inputs are available on the digital connector at the lower rear of the meter. The Power and the Voltage to be measured are applied to the upper connector. The instrument operates on 115v or 230v 50-60Hz power.

Other Newport panel instruments including Series 270 Digital Comparators and Model 800 Printers may be interconnected to the Series 400A/S without modification or external logic.

## 1.2 SPECIFICATIONS

| DC VOLTAGE METERS | | | | |
|---|---|---|---|---|
| Model | 400A/S-2 | 400A/S-3 | 400A/S-4 | 400A/S-5 |
| Full Scale | ±399.9mv | ±3.999V | ±39.99V | ±399.9V |
| Resolution | 100uV | 1mV | 10mV | 100mV |
| Impedance, Ohms | 1 G | | 10 M | |
| Input Bias (High Side) | 0.2 na typ; 1na max | | < .1na | |
| Maximum Overdrive | 200V | | 500V | |
| Maximum Error 15-35°C, 30 days | 0.1°/oR± 0.05°/oFS | 0.1°/oR± 0.025°/oFS | 0.15°/oR ±0.05°/oFS | |
| Temperature Stability 0 to 15°C and 35 to 50°C | (.005 /oFS ±.01 /oR) /°C | (0.0025°/oFS ±0.01°/oR)/°C | | |

| | DC CURRENT METERS | | | | |
|---|---|---|---|---|---|
| Model | 410A/S-2 | 410A/S-3 | 410A/S-4 | 410A/S-5 | 410A/S-6 |
| Full Scale | ±39.99ua | ±399.9ua | ±3.999ma | ±39.99ma | ±399.9ma |
| Resolution | 10na | 100na | 1ua | 10ua | 100ua |
| Voltage Drop | 400mv, full scale | | | | |
| Maximum Overdrive | 3ma | 10ma | 30ma | 100ma | 500ma |
| Maximum Error, 15-35°C, 30 days | ±0.15°/oR ±0.05°/oFS | | | | |
| Temperature Stability 0 to 15°C and 35-50°C | (.005°/oFS + .01°/oR)/°C | | | | |

| | |
|---|---|
| Reading Rate | Synchronized to the line, 4/sec to 60/sec programmable by external resistance. |
| Settling Time | After full scale step input, to within one digit, 140 ms standard, from 2 to 1000 ms on special order (see option SF) |
| Normal Mode Rejection | 20 db (60Hz) with standard filter. |
| Polarity | Automatic |

| | |
|---|---|
| Common Mode Rejection, DC to 60 Hz | |
| To Power line, case | 100 db |
| To BCD common | 70 db |
| Common Mode Voltage to meet CMR Specification | |
| To Power line, case | 300 volts |
| To BCD common | 8 volts max., either input of a 400mV or 4V meter or either lead on the output of the input attenuator of a 40V or 400V meter. |
| Remote Controls | Hold, BCD Enable, and display blanking |
| Calibration | Full scale, zero, and bias current adjustments accessible from rear panel |
| Operating Temperature Range | 0 to 55°C |
| Storage Temperature Range | -40 to +80°C |
| Display | 0.55 inch, 7 segment, planar, gas discharge numerals with + and - indicators. Overload blanks three least significant digits. |
| Power | 115 VAC or 230 VAC ±10%, 50/60 Hz, 6 watts max. |
| Enclosure | 2.2" high x 4.35" wide x 4.5" deep extruded aluminum case and bezel (option A3). Removable name plates for replacement by customer nomenclature. |
| Weight | Less than 3 pounds, net; 5 pounds, shipping. |
| Analog (Top) Connector | Keyed between pins 13 & 14 |
| Digital (Lower) Connector | Keyed between pins 3 & 4<br>Manufacturers type: SAE SAC15D/1-2<br>Viking 2VH15/1AN5<br>Cinch 251-15-30-160 |
| Connector Key | Manufacturers type: SAE 007900<br>Viking 091-0024-000<br>Cinch 456-99-99-193 |

## SECTION 2

## RECEIVING AND INSTALLATION

### 2.1 Unpacking and Inspection

Your Series 400A/S digital panel meter has been carefully inspected and tested before shipment. Unpack the meter and perform a visual inspection to assure that no damage has occurred during shipment or handling. These meters are factory sealed units. The only controls that may require periodic adjustment are accessible through the rear panel. Because extensive damage could result from attempts to measure circuit parameters or to trouble-shoot the meter by non-factory personnel, the warranty is voided if the unit has been removed from its case and shows signs of unauthorized repairs.

### 2.2 Installation-Mechanical

Drawing 04415 illustrates the detailed method of mounting the panel meters for each of the three mounting options. All critical dimensions are shown including those for the panel cutout.

| MOUNTING STYLE | DESCRIPTION |
|---|---|
| A1 | Unit is mounted flush on studs behind a rack panel. |
| A2 | Unit is mounted behind a rack panel by inserting the furnished 6-32 screws through the rack panel and into threaded holes in the case. |
| A3 | Unit is mounted through the rack panel from the back and held in place from the rear by a "U" bracket. The mounting cutout is hidden by the instrument bezel. |

# SECTION 3

# OPERATING INSTRUCTIONS

## 3.1 Power

### Description

The standard meter operates from a 115V or 230V, ±10%, 50-60 Hertz power source. It dissipates approximately 6 watts. It should be connected to the power source by a three conductor cable. Two conductors provide the power to the meter and the third provides safe grounding of the case. The third conductor should connect to earth ground at the power end of the cable and to the Analog Connector at the meter end of the cable. A wire from the Analog board to a locking terminal lug completes the connection to the case when the lug is secured by the rear panel screw.

> **CAUTION**
>
> Accidental connection of power to the Digital Board may result in catastrophic failure.

### Wiring Detail, 115 VAC Operation

The power cable is connected as follows to the top or Analog Board.

(a) To Pins 15 and S connect the high or "hot" side of the 115V power line.

(b) To Pins 14 and R connect the low or "cold" side of the 115V power line.

(c) To Pins 13 and P connect the earth ground or "third wire".

### Wiring Detail, 230 VAC Operation

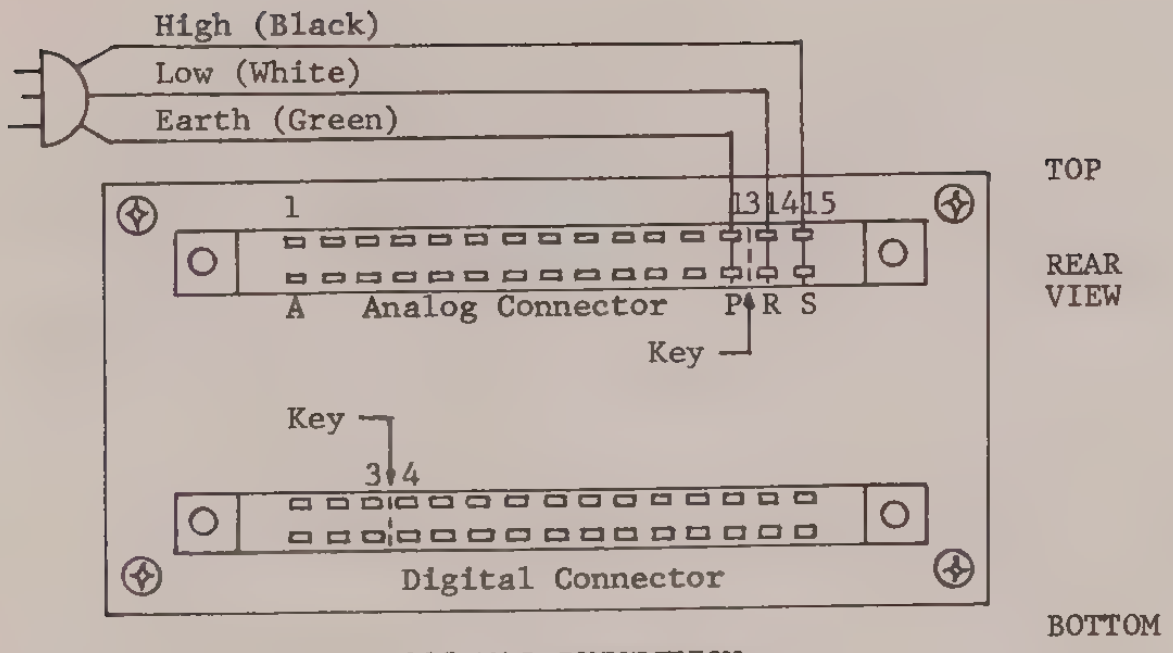
The power cable is connected as follows to the top or Analog Board.

(a) To Pin 15 connect the high or "hot" side of the 230V power line.

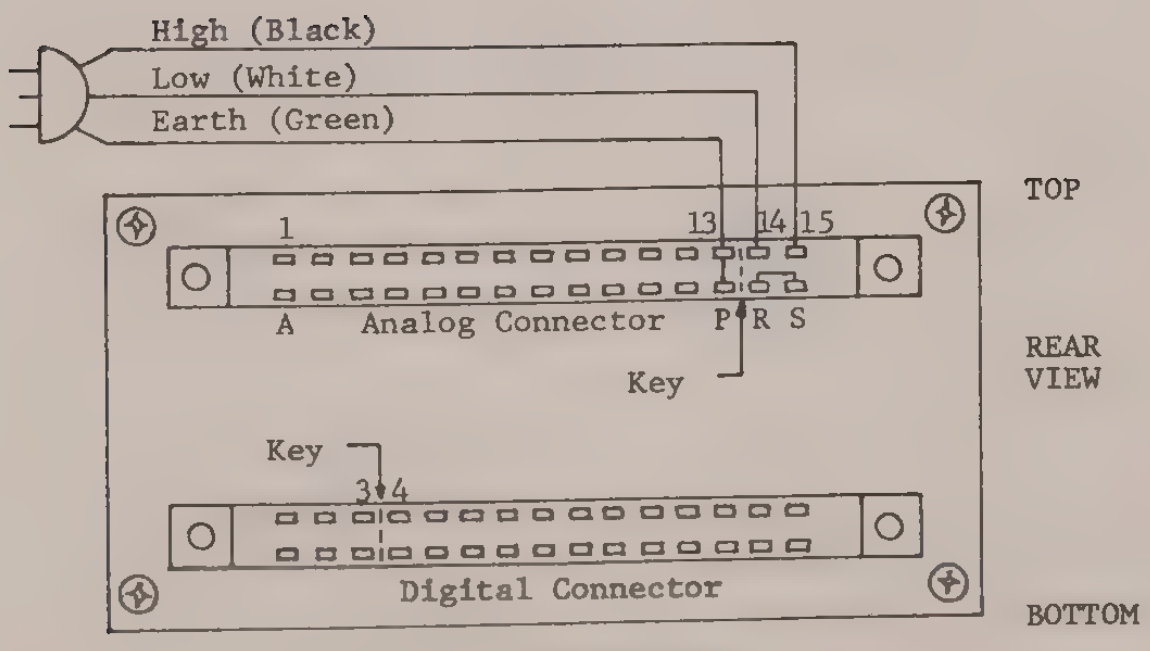
(b) To Pin 14 connect the low or "cold" side of the 230V power line.

(c) Jumper Pin R to Pin S.

(d) To Pins 13 and P connect the earth ground or "third wire".




115 VAC CONNECTION




230 VAC CONNECTION

## 3.2 Signal Inputs

### Introduction

The 400A/S series of panel meters employs a differential bipolar input circuit capable of operating with 8 volts of common mode voltage between either lead of the input amplifier and digital ground.

The input impedance for the 399.9mV and 3.999V meters is 1000 megohms minimum. An input attenuator is added to produce the 39.99V and 399.9V meters. The input impedance of the attenuator is 10 megohms.

### BIPOLAR INPUT - MODEL 400A/S

### Description

The basic bipolar input is a differential input circuit with common mode isolation up to ±8V between either input lead and digital ground. The latter constitutes the reference ground for the external control and BCD output circuits. Floating inputs require the addition of an external common mode path between the input leads and circuit ground. For this reason two wiring details are presented, one for grounded inputs and one for floating inputs. The input should be considered floating only if the meter ground is in no way connected to the circuit being measured. If the input is floating but can be connected to meter ground, the Grounded Input wiring detail should be used. Circuit ground is isolated with respect to the case or earth ground up to a potential difference of ±300V.

### 3.2.1 Wiring Detail - Grounded Input

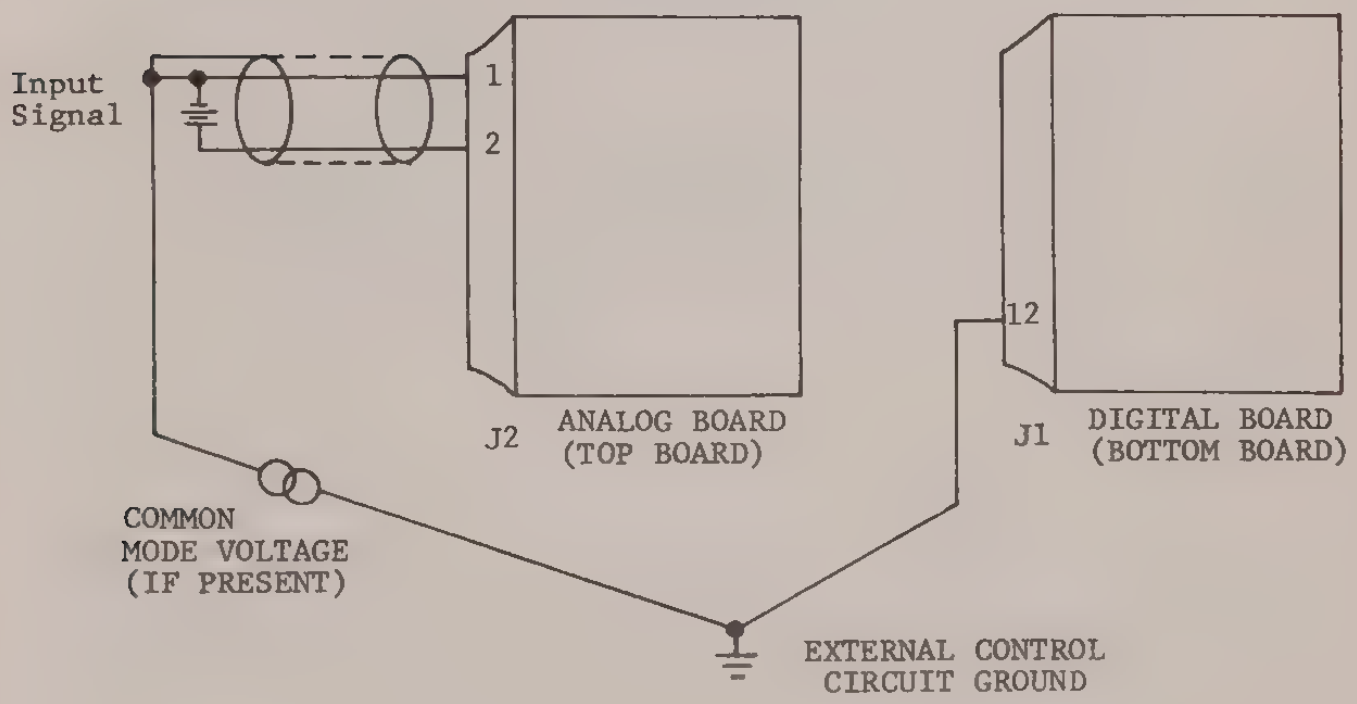
If the signal to be measured is referenced to the meter ground, it will be considered to be a Grounded Input. The Common Mode Voltage between either lead of the input amplifier and meter ground (if present) should be no more than 8 volts.

For best results the input signal to the meter should be connected to the top (Analog) board by a twisted shielded cable.

(a) To Pin 2 connect the high side of the input signal.

(b) To Pin 1 connect the low side of the input signal.

(c) Connect the shield to low side of the input signal. Leave the opposite end of the shield unterminated.




INPUT SIGNAL CONNECTIONS - BIPOLAR INPUT - INPUT GROUNDED

### 3.2.2 Wiring Detail - Floating Input

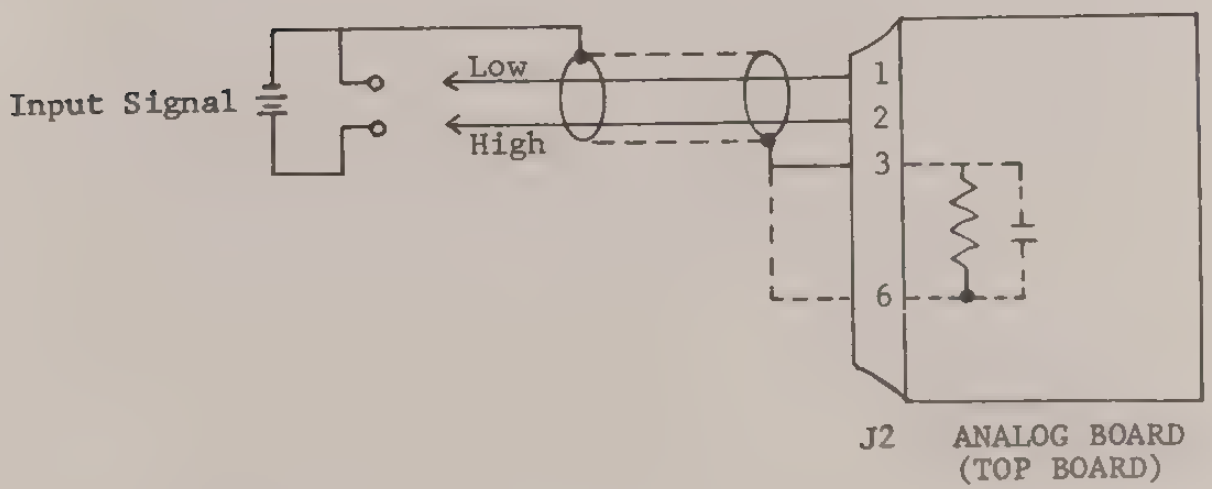
When the input voltage source is completely floating from meter ground (eg. a battery), the common mode voltage will exceed the 8V limitation due to the lack of a low impedance path for the input bias current between the input leads and circuit ground. The effect is for the readings to bounce erratically. To reduce the common mode voltage to less than 8V, pin 1 should be returned to circuit ground pin 6, through the internal network on pin 3.

(a) To Pin 2 connect a high side of the input signal.

(b) To Pin 1 connect the low side of the input signal.

(c) To Pin 3 (Guard) connect the meter end of the shield. Connect the other end of the shield to the low side of the source.

(d) If the meter is used for visual readout only (eg. no external control) connect a jumper from pin 3 to pin 6.




INPUT SIGNAL CONNECTIONS - BIPOLAR INPUT - INPUT FLOATING

## 3.3 Input Characteristics

### Input Source Resistance - Bipolar Model 400A/S

Maximum bias current for 399.9mV and 3.999V meters is 1na. One digit of offset will be generated by input source resistances of 100K and 1M Ohm respectively. The error due to source resistance may be minimized with the offset bias current control of the meter.

### Input Filter

The standard input filter is a single section low pass filter having a cutoff frequency (-3db) of 8Hz. The settling time to .1% is 140ms.

The filter cutoff frequency may be factory altered by changing the value of a capacitor to provide either a shorter settling time for faster response or a lower cutoff frequency for better noise rejection.

Since the filter is connected directly to the input, any equivalent source impedance will act to lower the cutoff frequency and increase the noise rejection and settling time. By putting resistance in series with the high input, input filter characteristics may be easily changed.

## 3.4 Digital Inputs/Outputs

The logic levels present at the digital connector are DTL and $T^2L$ compatible.

(a) Input Requirements:

Low level 0 to +.5V, sink 1.6ma

High level +2.0 to +5.5V, source .1ma

(b) Output Specifications:

Low level 0 to +.5, sink 5ma

High level +2.4 to +5.5V, source 6K Ohm

### EXTERNAL CONTROL

The digital panel meter provides a choice of several external control modes. This choice of modes allows the meter to satisfy a wide variety of interface requirements when used as a systems component.

The meter has a basic read rate of 4 conversions per second, but is capable of making measurements at a maximum rate of 60 conversions per second when the 60 Hz Read Rate input is grounded. Each conversion is synchronized to the 60 Hertz power line and always starts at the same point on the power line cycle. By means of external control any number of these cycles may be skipped with the meter retaining the reading corresponding to the last conversion. When the external command is given for a new reading the meter waits until the next synchronization point is reached on the power line cycle before starting the conversion.

The basic external control functions are labeled Hold and Data Ready. After the Hold signal goes false (low) the meter starts a new conversion process at the next synchronization point on the cycle. At the conclusion of the conversion process and before the next synchronization point occurs, the Data Ready signal goes true (high). This indicates that the conversion process is complete and the information present on the data outputs is ready for use. A test input is provided which, when connected to digital ground, causes the display indicator to light all segments.

### 3.4.1 Hold

The Hold input controls the start of each conversion process. A low level enables and a high level (or open) disables the conversion process.

An internal storage element allows one more reading to occur after the Hold input goes high. When this is undesirable an internal jumper on the digital board may be cut to disable the storage feature.

#### Operation with Storage

The meter is normally furnished with storage. The application of a low Hold input sets the storage element which then remains set after the Hold input goes high. The storage element is reset by the start of the next conversion cycle. The effect is to provide one more measurement after the Hold input goes high. The following three modes of operation exist with the storage option.

#### Level Mode

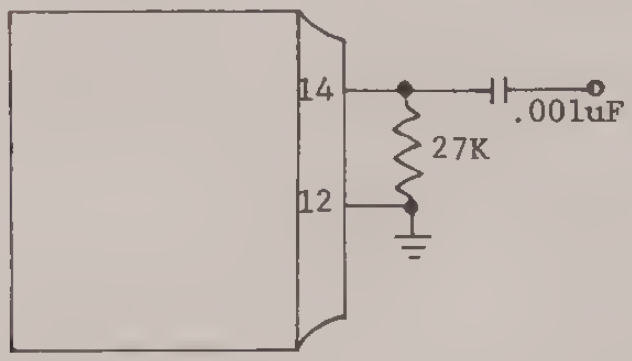
While the Hold input is maintained false (low), measurements occur at the selected reading rate. While it is true (high), the last measurement made is held in memory. One more measurement is made after the Hold input goes high. It is this measurement that is held in memory as long as the Hold input remains true.

#### Pulse Mode

A pulse that goes low at the Hold input for a minimum of two microseconds and terminates before the next synchronization point on the power line cycle will set the storage element and initiate a conversion cycle starting at the next synchronization point. If the pulse extends beyond the synchronization point, an additional conversion will occur. To insure that only one conversion is made, the pulse width must be less than 300 microseconds.

## Transition Mode

This mode requires an external .001 microfarad capacitor and a biasing network to be connected to the Hold input as shown.




A negative-going transition of the Hold signal will set the storage element and provide one conversion starting at the next synchronization point. The amplitude of the transition must be 3 to 5 volts with a fall time of less than 1 microsecond. The Hold Signal must be low for 1us minimum and high for 100us minimum.

## Operation Without Storage

There are applications (eg. when the BCD outputs are connected to a printer) for which it is desirable to disable the storage function. This is accomplished by cutting or removing jumper W11 on the digital board. This insures that when the Hold input goes high, no more conversions take place and the BCD outputs remain static for use by an external device.

## Wiring Detail

The Hold input signal is connected to the bottom (Digital) board.

(a) To Pin 14 connect the high side of the input.

(b) To Pin 12 connect the low side or ground return of the Hold input.

### 3.4.2 Data Ready

Two modes of operation exist for the Data Ready output signal, the Conventional Mode and the Reset Mode. The Conventional Mode is operational when the meter is shipped. The Reset Mode requires that the storage circuit be operational and that the two control lines labeled Ready and Data Ready Enable be shorted together.

#### Conventional Mode

The Data Ready signal goes true (high) to indicate the completion of a conversion process and remains true until the next conversion process is started. During this time the BCD outputs represent the value of the measurement and are available for use by an external device. The Data Ready signal normally remains true for at least 6 milliseconds but this time may be extended indefinitely with a high level on the Hold input.

#### Reset Mode

With the Data Ready Enable input connected to the Ready output, the Data Ready signal goes true to indicate the completion of the conversion process AND the reset condition of the storage element. The Data Ready signal goes false to indicate the EITHER the conversion is in progress OR the Hold signal has been made false (low) to set the storage element since the last conversion started. This mode is useful when interfacing with an external device that requires the Data Ready signal to go false immediately when the Hold input goes false.

#### Wiring Detail

The Data Ready, Ready, and Data Ready Enable connections are available on the bottom (Digital) board.

(a) Pin 1 - Data Ready output signal.

(b) Pin 12 - Ground reference for the Data Ready output signal.

(c) Connect Pin 3 (Data Ready Enable) to Pin 13 (Ready) only if the Reset Mode of operation described above is desired.

### 3.4.3 Decimal Points

Each of the four digits of the decimal readout has a left-hand decimal point which may be lighted to provide the proper decimal point representation of the quantity being measured. All four decimal points are available at the connector and may be individually selected by external circuitry.

#### Wiring Detail

The decimal point locations are designated by representing the four full decimal digits by X's and placing the decimal point in the position corresponding to its display location. The decimal point connections are available on the bottom (Digital) board.

(a) Pin 7 - Decimal Point XXX.X

(b) Pin 8 - Decimal Point XX.XX

(c) Pin 9 - Decimal Point X.XXX

(d) Pin 10 - Decimal Point .XXXX

(e) Pin 12 - Ground Reference

Any decimal point may be lighted by connecting the designated pin to ground, Pin 12, either with a jumper or through relay contacts. A solid state switch could also be used if it is rated for 3ma in the ON state and is capable of blocking 70 volts with a leakage of less than 1 microampere in the OFF state.

### 3.4.4 BCD Outputs

Positive true BCD outputs representing each digit of the readout as well as overload and polarity are standard. The Overload output goes true when the input voltage exceeds the full scale rating of the meter. The Positive Polarity output goes true when the polarity of the input signal is positive.

The BCD, Polarity, and Overload outputs are settled and ready for acceptance by an external device when the Data Ready signal goes true. The data may be held indefinitely by maintaining a true level at the Hold input.

The BCD outputs of the Series 400A/S are buffered and gated. Connecting a low signal to BCD Enable Pin 5 causes all the BCD outputs to go high. The gated BCD lines from several meters may be multiplexed by parallel wiring the outputs. By sequentially enabling each meter its BCD outputs will appear on the common buss.

Wiring Detail

This data occupies 15 pins on the lower half of the bottom connector. The pin designations are listed on the pin assignment list. Digital ground, pin 12, should be used as the common reference for these signals.

### 3.4.5 Blanking

To blank the display connect a high signal (+2.4 to +5.5, source 1ma) to Blanking Pin 15 on the bottom (Digital) board. This will cause the display to extinguish.

Wiring Detail

To Pin 15 connect the signal (+2.4 to +5.5, 1ma)

To Pin 12 connect the signal ground reference.

### 3.4.6 Conversion Rate

When shipped, the meter will make readings at a rate of 4/sec. To increase this rate to 60/sec. the 60 Hz Read Rate input must be grounded. By connecting a resistor between the 60 Hz Read Rate input and ground, conversion rates between 4/sec. and 60/sec. may be selected. See chart below for approximate values.

Wiring Detail

Connect a jumper or fixed resistor with short leads between Pin 6 and Pin 12 to obtain read rates above 4/sec.

| Conversion Rate | Resistance |
|---|---|
| 60/sec. | Short |
| 30/sec. | 220K |
| 15/sec. | 820K |
| 8/sec. | 2.2 Meg |
| 4/sec. | Open |

### 3.4.7 Test

Connect a jumper between pin 11 and pin 12 of P1 to light all segments of the readout.

## 3.5 400A/S Pin Assignments

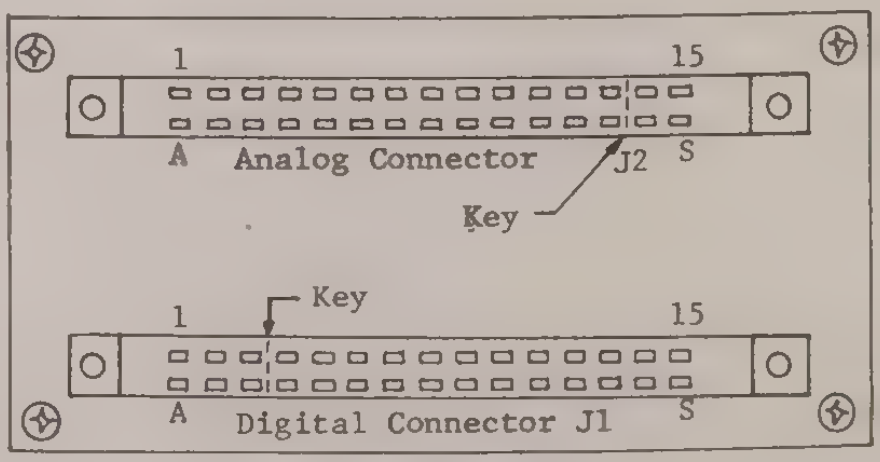
### DIGITAL CONNECTOR (LOWER) P1

| FUNCTION | | PIN NO. |
|---|---|---|
| BCD Output: | 1 bit | A |
| | 2 | B |
| | 4 | C |
| | 8 | D |
| | 10 | E |
| | 20 | F |
| | 40 | H |
| | 80 | J |
| | 100 | K |
| | 200 | L |
| | 400 | M |
| | 800 | N |
| | 1000 | P |
| | 2000 | S |
| Overload (4K) | | 4 |
| Pos. Polarity | | R |
| Circuit Gnd (Dgtl) | | 12 |
| Hold | | 14 |
| Data Ready | | 1 |
| Decimal Pt at: | XXX.X | 7 |
| | XX.XX | 8 |
| | X.XXX | 9 |
| | .XXXX | 10 |
| 60Hz Read Rate | | 6 |
| Ready | | 13 |
| Data Ready Enable | | 3 |
| Blanking | | 15 |
| Test | | 11 |
| BCD Enable | | 5 |
| Internal Conn. | | 2 |

### ANALOG CONNECTOR (UPPER) P2

| FUNCTION | | PIN NO. |
|---|---|---|
| Input: | Low | 1 |
| | High | 2 |
| Guard | | 3 |
| Circuit Gnd (Anlg) | | 6 |
| Power: | | |
| 115V 60Hz | Earth Ground | 13 & P |
| | Lo | 14 & R |
| | High | 15 & S |
| 230V 60Hz | Earth Ground | 13 & P |
| | Lo | 14 |
| | High | 15 |
| | Jumper | R & S |

NOTE: To enable continuous reading connect pin 14 to pin 12 on the digital connector.




REAR VIEW

SECTION 4

THEORY OF OPERATION

## 4.1 General

The Series 400A/S digital panel meters basically accept DC analog voltages at their input and display the value digitally with cold-cathode glow tubes. The value is also available electrically in BCD form at the digital connector. The inputs to the 400mV and 4V full scale meters are connected directly to the input amplifier. The 40V and 400V full scale meters are basic 4V meters with a 10:1 and a 100:1 attenuator respectively. The current meters are basic 400mV full scale meters with a shunt dropping resistor across the input.

## 4.2 Timing

The conversion process is synchronized to the 60 Hz power line as shown in the timing diagram below. Conversion takes place during the negative portion of the cycle. During the positive half cycle the reading is held and the half-wave rectified high voltage is applied to the display tubes.

The reference current is integrated for a period of time proportional to the reading. It is zero for a reading of zero, 6ms for a reading of full scale and greater than 6ms for an overload input.

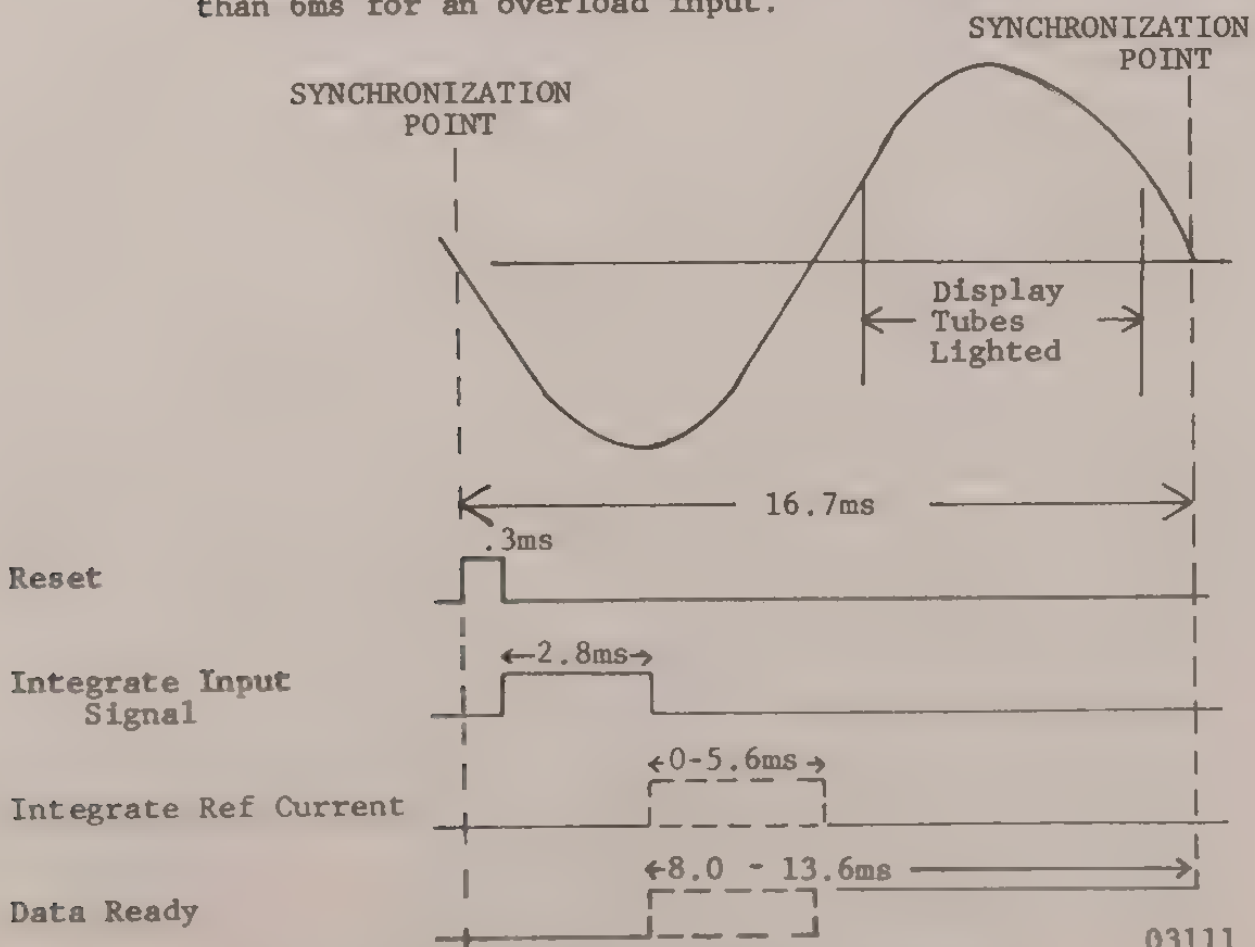



FIGURE 4-1 SIMPLIFIED TIMING DIAGRAM

Refer to the simplified block diagram (figure 4-2) and basic timing diagram (figure 4-1).

The measurement cycle begins when the reset circuit detects the zero crossing of the falling edge of the AC line and generates a reset pulse. This reset pulse sets the BCD counter to a count of 9000 and sets the I-SW flip flop, U5, to the Signal Integrate state. The I-SW flip flop output causes the current switch to switch the signal current sink to the integrating capacitor and turns the gated oscillator on. When the integrating capacitor begins to charge down, the clamping comparator output goes high.

After 2000 counts the BCD counter overflows, the I-SW flip flop is set to the Reference Integrate state, causing the current switch to select the reference current source. At this time the BCD counter is at 0000 counts. The integrating capacitor discharges at a constant rate back to its initial charge at which time the clamping comparator goes low, turning the gated oscillator off. The number of counts now in the BCD counter is equal to the input voltage and the data ready signal goes true. The display is turned on each half cycle during the time data is stable.

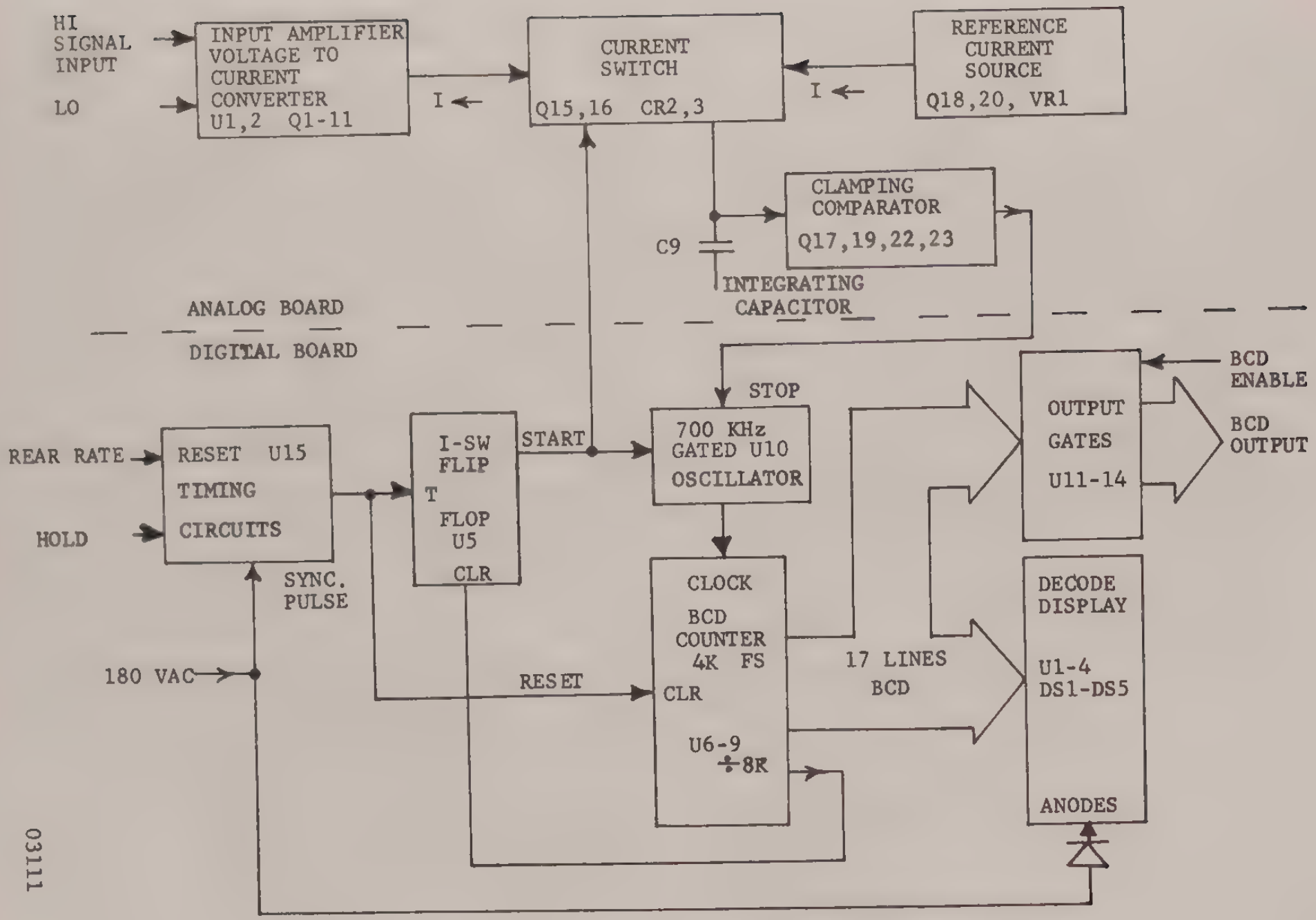
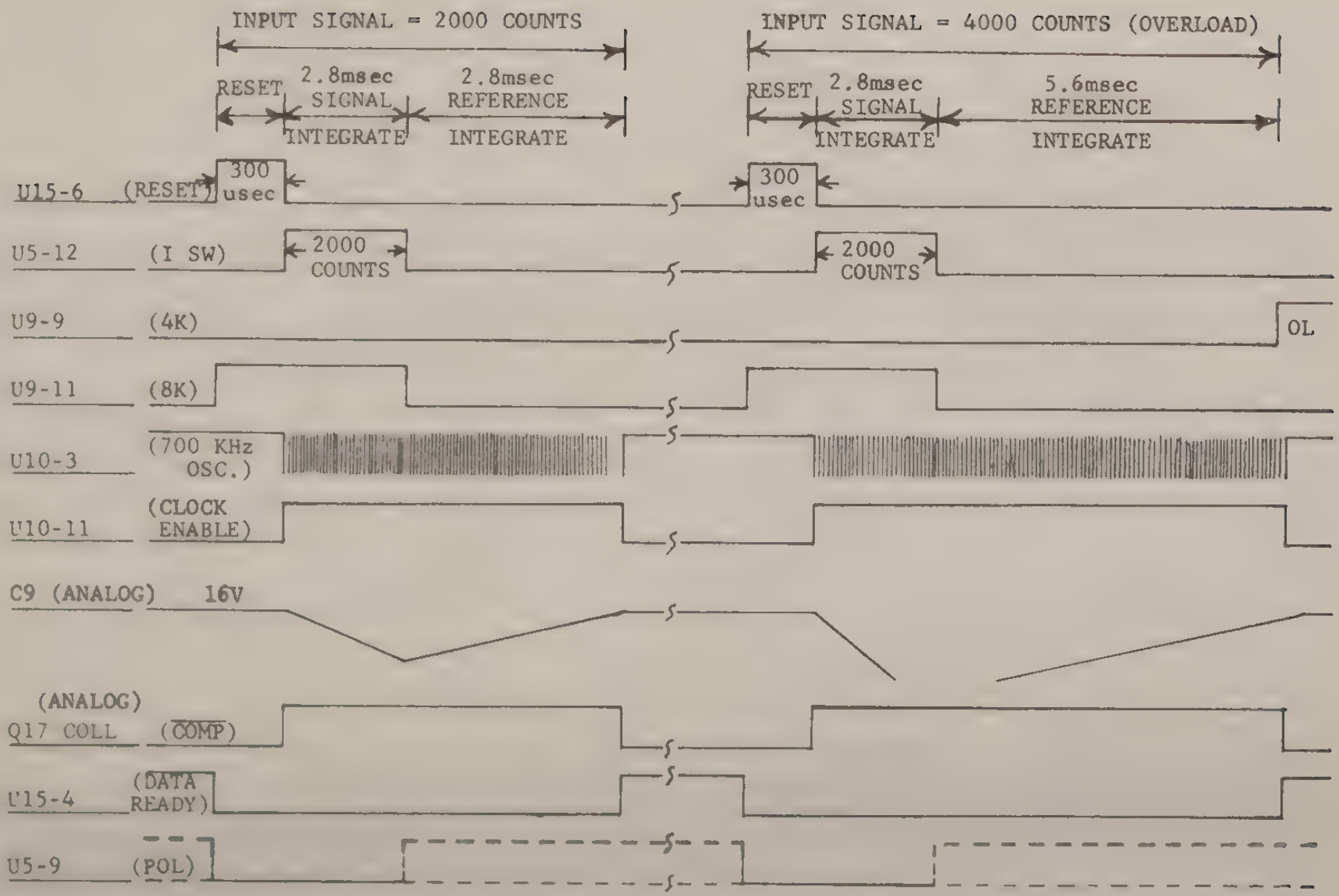



FIGURE 4-2 SIMPLIFIED BLOCK DIAGRAM




TIMING DIAGRAM 400A/S FIGURE 4-3.

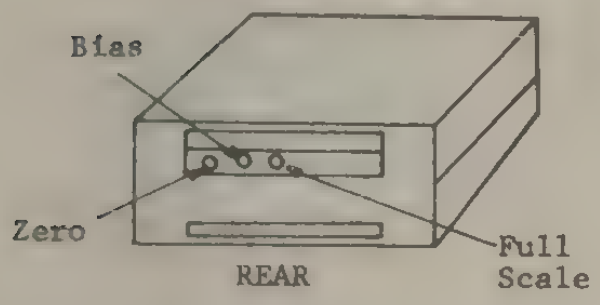
## SECTION 5

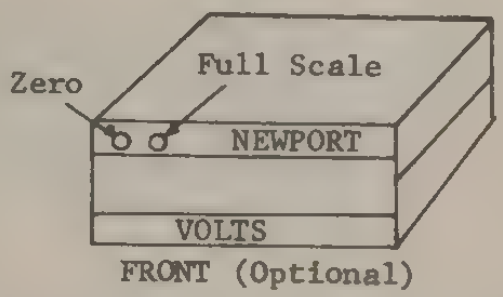
## MAINTENANCE AND CALIBRATION

### 5.1 Introduction

There are two standard adjustments available on the basic digital panel meter. These are the Zero or Balance adjustment and the Full Scale adjustment. These controls are located at the rear of the meter.

All controls should be adjusted with an insulated screwdriver according to the following instructions. Always allow at least 30 minutes warm-up time before making the adjustments.




### 5.2 Calibration Adjustments (For set up see Initial Checkout Procedure)

#### 5.2.1 Zero (Balance)

This control is located at the rear of the meter in the upper left hand corner. It adjusts the zero offset of the input amplifier which affects balance between the plus and minus ranges of the bipolar meter.

With the input signal leads shorted and a negative reading on the meter, slowly rotate the Zero adjustment in the positive direction. Stop at the instant the polarity indicator switches from minus to plus.

To check the adjustment, apply an input signal equivalent to 10 counts. If the zero adjustment is correct, the meter will display the same reading (except for polarity indication) when the signal polarity is reversed.

### 5.2.2 Full Scale

This control is located at the rear of the meter in the upper middle of the back panel. It adjusts the full scale reading of the meter. For best results this adjustment should be made with an accurately known input set between 1/2 and 3/4 of full scale. It is most accurately set by applying to the input a voltage known to .01% which has a value half way between two consecutive readings on the meter. The control is then adjusted until the reading bounces between these values.

This adjustment should not be attempted until the previous Zero adjustment has been performed.

### 5.2.3 Input Bias

This control is located at the rear of the meter and normally needs no adjustment. It adjusts the amount of offset current coming out the high input lead. To null this current first short the input leads to make sure the meter is zeroed, then place a 1 meg resistor in series with the high lead. By adjusting the bias control this reading can be adjusted to zero.

## 5.3 Maintenance and Repair

Due to the complex operation of this instrument and special laboratory test equipment needed to repair it, no attempt should be made to troubleshoot the circuit cards in the field by untrained personel.

Before returning the instrument to the factory, every attempt should be made to insure that the instrument is actually at fault and that the trouble is not in the set up. The best way to insure this is by substituting a known working instrument. Alternately, the meter should be removed from the set up and tested by using a battery or power supply as an input source.

If the instrument is found to be at fault, please fill out the Returned Material Authorization and return with the unit. The best way to insure that the defect will be quickly found and repaired is to include a diagram of your actual test conditions, so that the factory will be able to duplicate the failure easily.

If customer repair is to be undertaken, the following guide will assist in the tracing of a fault to a functional area of the meter.

Test 1

After determining that the power supplies are furnishing the correct voltages, hook up the meter per the initial checkout procedure in the front of this manual. Apply a positive and then a negative voltage to the input signal terminals. If the + and - indicators do not follow the input signal, look at the logic level at U5 pin 7 (digital). If this signal does not follow the polarity of the input signal, the trouble is likely in the input amplifier circuitry on the analog board.

Test 2

If the signal at U5 pin 7 (digital) is correct, ground U10 pin 9 (digital). The readout should be 0000.

Test 3

Remove the ground from U10 pin 9 (digital) and ground P1 pin 11. The readout should be 8888 (flickering). If this test or test 2 produces incorrect results the trouble is on the digital board.

Using the results of these tests, the simplified block diagram, figure 4-2, will assist in tracing the malfunction to a functional block of the meter.

Test 1 indicates if the input amplifier is following the input signal polarity. Test 2 simulates a comparator input to the digital circuitry as if the analog board was working with zero input. Test 3 simulates no comparator input to the digital circuitry as if the analog board was working with an overloaded input. If all three tests give correct results, look for the trouble in the reference current source or the current switch circuits. Use a scope to look at the top of C9 (analog) using a 10M Ohm probe with a full scale input signal. A waveform should be observed ramping from approximately +15v to a point several volts lower during the time the signal at U5 pin 12 (digital) is at a positive level (Signal Integration Time) and then ramping back up when the signal at U5 pin 12 is at a lower level (Reference Integration Time).

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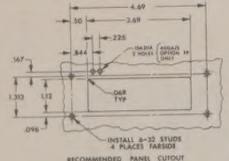
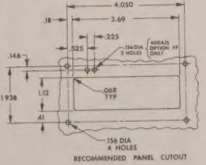


RECOMMENDED PANEL CUTOUT



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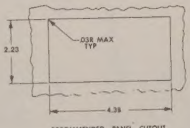

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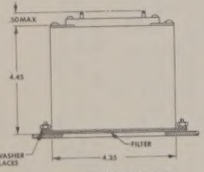
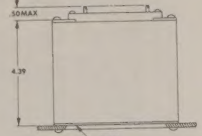
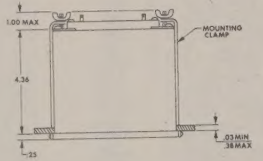
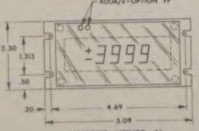
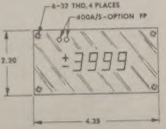


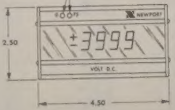



MOUNTING METHOD A1



MOUNTING METHOD A2



MOUNTING METHOD A3

1. REFERENCE OWNER'S MANUAL 03111.
NOTE: UNLESS OTHERWISE SPECIFIED

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| DR B. Ennis | 7-7-78 |
| CHKD [illegible] | 7-7-78 |
| APPD [illegible] | 7-10-78 |

USE OF THIS PROPRIETARY INFORMATION IS RESTRICTED TO MAINTENANCE OR BUY PRODUCTS.

NEWPORT LABORATORIES, INC.
630 S. YOUNG ST. SANTA ANA, CALIF. 92705

TITLE: OUTLINE & MOUNTING A1, A2 & A3 MODEL 400A/S

| CODE IDENT | SIZE | NO |
|---|---|---|
| 32873 | D | 04415 |

SCALE: NONE | MODEL 400A/S-1PT | SHEET 1 OF 1

• POWER SUPPLIES • DIGITAL COMPARATORS • DIGITAL MICROVOLT METERS

• DIGITAL PANEL COUNTERS • DIGITAL PROCESS MONITORS • TRANSDUCER CONDITIONERS • COUNTER/TIMERS

MP MASTER

MA23749

ACHOMETER / COUNTERS • REMOTE DISPLAYS • DIGITAL DATA PRINTERS •